



THE CSS POINT
Yes We Can Do It!

Endocrine Glands System

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Introduction

- Endocrine means ‘secreting internally’.
- Indeed, the endocrine system is made up of glands whose secretions enter the blood stream.
- Hence these glands are different from those whose secretions are released on the surface of the body, like the sweat glands or the tear secreting glands.
- The endocrine glands are sometimes referred to as ‘ductless’ glands.
- This is to differentiate them from another set of glands (**exocrine**).
- Exocrine glands have a duct or tube which carries the secretions to the place where it should act.
- In contrast, the secretions of endocrine glands (**ductless**) enter the blood stream directly.
- These secretions are called **hormones**.

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- ▶ The endocrine system is concerned with the maintenance of homeostasis or internal balance
 - ▶ Glands comprising the endocrine system;
 - Pituitary → brain
 - Thyroid & parathyroid → neck
 - Adrenal glands → top of each kidney
 - Pancreas → abdomen
 - Gonads → pelvis (ovaries & testes)
 - Thymus → chest
 - Pineal → brain

Endocrine Glands

- ▶ Glands are small but powerful organs that are located throughout the body. They control very important body functions by releasing hormones.

The following list of glands make up the endocrine system.

- ▶ Pituitary Gland
- ▶ Hypothalamus
- ▶ Thymus
- ▶ Pineal Gland
- ▶ Testes
- ▶ Ovaries
- ▶ Thyroid
- ▶ Adrenal Glands
- ▶ Parathyroid
- ▶ Pancreas

Glands at glance

- ▶ **Pineal gland:** Cone-shaped gland at the base of the brain that secretes the hormone melatonin, which may help to synchronize biorhythms and mark the passage of time.
- ▶ **Pituitary gland:** A gland that signals other glands to put forth hormones. The pituitary also secretes growth hormone, and anti-diuretic hormone, prolactin, and oxytocin, a hormone which causes contractions of the uterus during labor.
- ▶ **Thyroid gland:** Produces the hormones thyroxin, triiodothyronine and calcitonin, which stimulate metabolism, body heat production and bone growth.
- ▶ **Parathyroid glands:** Endocrine glands whose hormones regulate the use and function of calcium and phosphorus in the body.

Glands at glance

- ▶ **Pancreas**: The abdominal organ which secretes insulin and glucagon, which control the utilization of sugar, the body's chief source of energy.
- ▶ **Adrenal glands**: The adrenals are two small glands which sit on top of each kidney. They release hydrocortisone, which effects metabolism. They also produce androgens such as DHEA and aldosterone, which maintains blood pressure and the body's salt and potassium balance.
- ▶ **Ovaries**: Female glands which produce the hormones estrogen and progesterone, produce eggs in the ovaries and influence female characteristics.
- ▶ **Testes**: Male glands which secrete testosterone, which stimulates sperm production and development of male characteristics.

Hypothalamus

- The hypothalamus is part of the brain that lies just above the pituitary gland.
- **The hypothalamus** has many essential functions, one of these is regulation of the endocrine system.
- It controls the endocrine glands through **releasing hormones**.
- This mechanism regulates the secretions of almost all the other glands.
- Exceptions are: a small part of the pituitary gland, the **posterior pituitary**, and the pancreas.

Pituitary Glands

- Located at the base of the brain.
- It is roughly pea sized, weighting approximately half a gram.
- The pituitary gland has been called the control centre of the endocrine system.
- It is under the control of the hypothalamus.
- There are 3 parts or lobes: Posterior, intermediate, and anterior.
- The intermediate lobe is thinner than the other two.

Posterior Pituitary (Neurohypophysis)

- The lobe stores two hormones.
- The hormones are produced in the hypothalamus.
- Their release is also controlled by the hypothalamus, which sends the necessary nerve messages to the posterior pituitary.
- The two hormones are **anti diuretic hormone (ADH) & oxytocin**.
- ADH controls the amount of water in the body.
- **OXYTOCIN** causes the contractions of the uterus which are necessary for child birth.
- It is also responsible for the release of breast milk.

Interior Pituitary (Adenopophysis)

- Produces the hormones which it secretes (unlike the posterior pituitary).
- Trigger signals to release these hormones, or not is sent by the hypothalamus.
- There are 6 main hormones: Two of them (**growth hormone & prolactin**) act directly on body tissues or processes.
- The other four hormones are **Stimulating Hormone (SH)**, which control the production of hormones in other glands: thyroid, adrenals, & gonads.

Hormones of Interior Pituitary

- **GROWTH HORMONE** controls the growth of the body during childhood, until adolescence.
- Too little of the growth hormone in childhood leads to dwarfism.
- Too much causes gigantism.
- Later on in life (adulthood), when the length of bones is fixed, too much of growth hormone causes thickening of the limbs and jaws, giving the person a distorted appearance.

Hormones of Interior Pituitary

- **PROLACTIN** has the effect of enlarging the breasts so that milk production occurs during pregnancy.
- **THYROID STIMULATING HORMONE (TSH)** promotes the secretion of the thyroid gland.
- **ADRENOCORTICOTROPIC HORMONE (ACH)** promotes the secretion of corticosterone by the adrenals.
- **GONADOTROPINS** include **FOLLICLE STIMULATING HORMONE (FSH)** and **LUTEINIZING HORMONE (LH)**, both of them stimulate the gonads (ovaries or testis) to produce ova or eggs/sperms.

TABLE 51-1 *Hormones Secreted by the Pituitary Gland*

Hormone	Target	Function
Adrenocorticotrophic hormone (ACTH)	adrenal cortex	stimulates secretion of cortisol and aldosterone by the adrenal cortex
Antidiuretic hormone (ADH)	kidney tubules	stimulates reabsorption of water by kidneys, reducing the concentration of solutes in the blood
Follicle-stimulating hormone (FSH)	ovaries in females; testes in males	stimulates egg production in females; stimulates sperm production in males
Growth hormone (GH)	muscle and bone	regulates development of muscles and bones
Luteinizing hormone (LH)	ovaries in females; testes in males	stimulates progesterone and estrogen production; initiates ovulation in females; stimulates testosterone production
Oxytocin	mammary glands and uterine muscles	initiates uterine contractions during childbirth; stimulates flow of milk from breasts during lactation
Prolactin (PRL)	mammary glands	stimulates milk production in breasts during lactation
Thyroid-stimulating hormone (TSH)	thyroid gland	regulates secretion of the thyroid hormones—thyroxine and triiodothyronine

Thyroid Gland

- Butterfly shaped gland located at the base of the neck just below the larynx.
- It is composed of 2 lobes, jointed together by a horizontal bridge.
- In adults it weighs approximately 20 g.
- The gland secretes **thyroxine**.
- Thyroxine controls the metabolic rate, i.e. the speed at which cells consume and process food and oxygen.
- Another secretion is calcitonin, which helps deposition of calcium in the bones.

Thyroxine

- ...increases the amount of energy used by the cell and increases heat production.
- ...stimulates bone growth.
- ...is essential for normal brain development. It is also necessary for the brain to function normally in adulthood.
- Iodine is essential for thyroxine formation.
- A lack of iodine in the diet will result in thyroid malfunction.

Parathyroid Glands

- There are 4 parathyroid glands.
- These glands are very small.
- They are present on the back surface of the thyroid gland.
- **Parathormone**, which is secreted by the parathyroids regulates the level of calcium in the blood.
- Hence it functions along with calcitonin which is secreted by the thyroid gland.
- In case too much of parathormone is secreted, calcium is removed from the bones.

Adrenal Glands

- The adrenal (suprarenal) glands are a pair of glands placed on top of each kidney, rather like a cap.
- Each gland is composed of two distinct parts: the central adrenal medulla and the surrounding adrenal cortex.
- The two parts have separate functions, which influence one another.

Adrenal Medulla

- The adrenal medulla produces the hormones adrenalin and noradrenalin.
- These are known as the 'fight or flight' hormones.
- The release of these hormones is controlled by the sympathetic nervous system.
- Their effects are similar to those of sympathetic nerve stimulation.

Adrenal Cortex

- Produces several hormones called steroids.
- These hormones are released as soon as stress is encountered.
- It is not actually known why these hormones are essential for the stress response.
- One belief is that they facilitate the action of adrenalin and noradrenalin.

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- ▶ These hormones have various functions:
 - Increase the blood sugar levels.
 - Control the use of salt in the body.
 - Distribution of fat.
 - Reduce sensitivity (allergic) reactions.
 - Antiinflammatory action. [inflammation = a reaction of the body to injury, irritation, & infection]
 - The hypothalamus triggers the secretion of the pituitary SH for the adrenal cortex, in respond to: pain, injury, & emotions.
 - These steroids have therapeutic use because of their **antiinflammatory** and **antiallergic** actions.
 - They are used for various diseases, such as arthritis, asthma, and certain skin diseases.
 - It is essential to know that steroids have serious side effects on prolonged use.

Gonads

- Are the reproductive glands – the testes in males, and ovaries in female.
- The 3 main hormones produced by the gonads are testosterone, estrogen, and progesterone.
- Both men and woman have all 3 hormones.
- In men testosterone is predominant, whereas in women estrogen and progesterone are mainly produced.
- Testosterone is concerned with development of the secondary sexual characteristics in males (facial hair, deepening of the voice).
- Estrogen has the same function (development of secondary sexual characteristics) in females.
- Both estrogen and progesterone play a role in menstruation and pregnancy.

Gonads Cont...

- **Estrogens** are required for the development of ova and for the formation of the physical characteristics (secondary sex characteristics).
- These characteristics include the development of the female reproductive system, the menstrual cycle begins, widening of the hips, and development of the breast. Puberty.
- **Progesterone** prepares the uterus for the arrival of a developing embryo - or controls the menstrual cycle.

Pancreas

- Located in the abdominal cavity.
- It is an endocrine as well as exocrine gland, the main function being to produce digestive juices.
- The hormone producing portion of the pancreas consists of clusters of cells that resemble islands, called **islets of langerhans**, function as an endocrine gland.
- Each islet is composed of **beta cells** which secretes **insulin**, and **alpha cells** which secretes **glucagon**, both concerned with control of blood sugar levels.

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- These two hormones, insulin and glucagon regulate the metabolism of blood glucose (sugar) and the hormones have opposite effects. (Antagonistic hormones)
 - Insulin stimulates its target cells to take up and use glucose. This action lowers blood glucose levels. "Use or store"

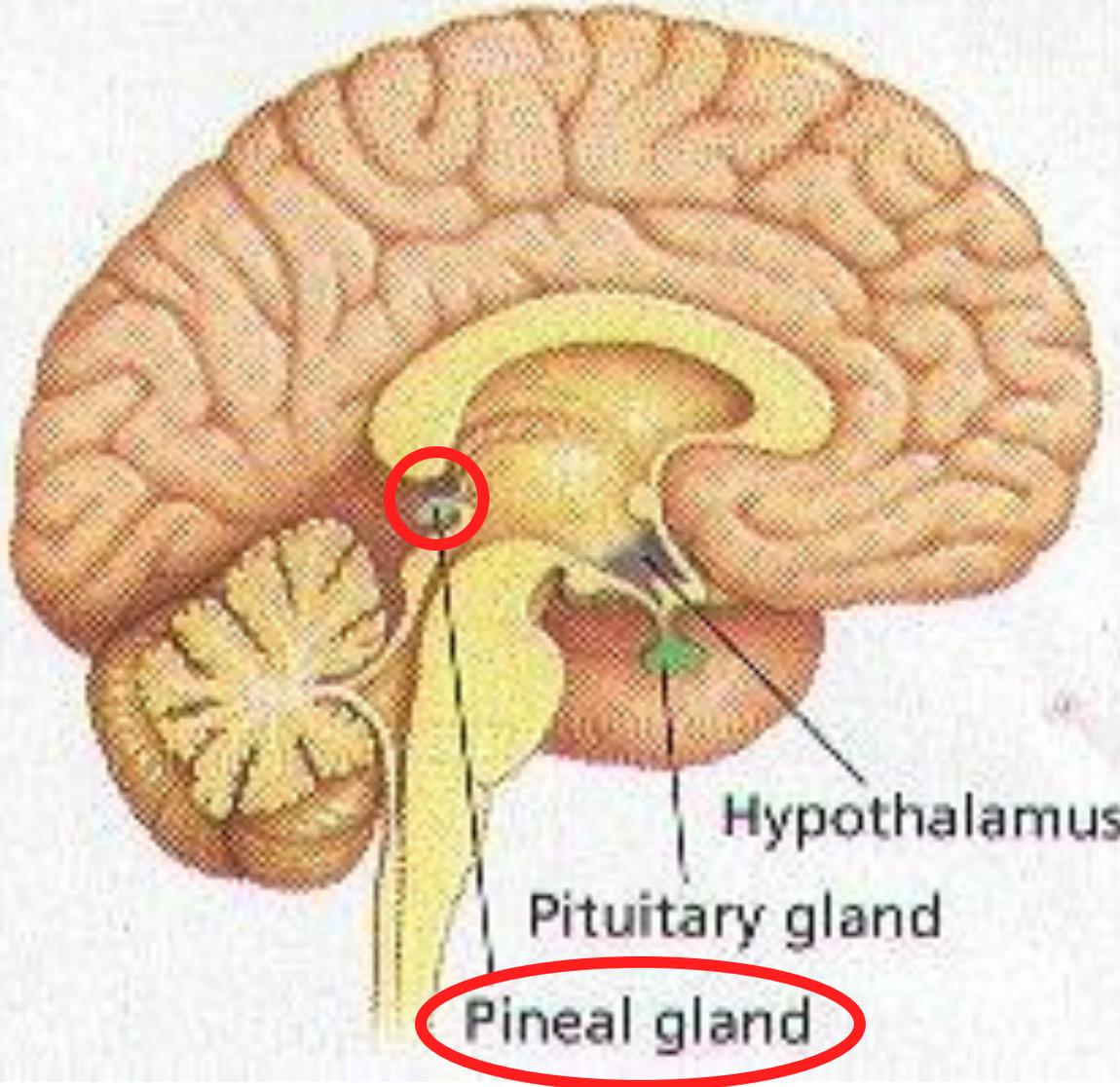
Insulin

- A very important hormone.
- It reduces the blood sugar level.
- It does this by causing sugar to enter the cells, and helping the cells to 'burn' the sugar in the blood, and convert it into energy.
- Insufficiency of insulin results in Diabetes Mellitus in which the blood sugar level is raised.
- An increase in blood sugar level is strong stimulus for insulin secretion.

Pineal Gland

- Is a tiny gland (approx. 5-8 mm by 3-5 mm)
- This gland begins to stop functioning before puberty.
- It secretes **melatonin**, which is secreted in greater amounts in the dark.
- Melatonin is believed to inhibit gonadal development.
- The function of the pineal gland is still being investigated.

THE PINEAL GLAND



▶ Located near the **base of the brain**.

▶ Secretes **Melatonin**.

Melatonin increases at night and decreases in the day. This cyclic release helps regulate sleep.

Thymus

- The thymus gland is located beneath the **sternum** (**breastbone**) and between the lungs.
- The thymus produces cells (**lymphocytes/ T-cells**) which play a role in the body's defense.
- Secretes **Thymosin**, an amino acid based hormone that stimulates the formation of t-cells, which help defend the from pathogens.
- Like the pineal gland, the thymus also starts to decrease in size around adolescence.

Prostaglandins

- ▶ 1. PROSTAGLANDINS are a group of hormone-like lipids, that also regulate cell activities.
- ▶ 2. Unlike hormones, prostaglandins are NOT produced by specific endocrine glands.
- ▶ 3. They are produced in small quantities by many cells throughout the body. They act locally.

TABLE 51-2 Summary of Endocrine Glands and Their Functions

Glands	Hormone	Function
Adrenal glands		
Cortex	aldosterone cortisol	maintains salt-and-water balance regulates carbohydrate and protein metabolism
Medulla	epinephrine, norepinephrine	initiate body's response to stress and the "fight-or-flight" response to danger
Ovaries	estrogen progesterone	regulates female secondary sex characteristics maintains growth of uterine lining
Pancreas (islets of Langerhans)	glucagon insulin	stimulates release of glucose stimulates absorption of glucose
Parathyroid glands	parathyroid hormone	increases blood calcium concentration
Pineal gland	melatonin	regulates sleep patterns
Pituitary gland	see Table 51-1	see Table 51-1
Testes	androgens (testosterone)	regulate male secondary sex characteristics
Thymus gland	thymosin	stimulates T-cell formation
Thyroid gland	thyroxine, triiodothyronine	increase cellular metabolic rates